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VOL. 104 NO. 2696 *Friday, 30 August 1946* PAGES 193-214

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SCIENCE

Vol. 104, No. 2696 Friday, 30 August 1946

Research in the Social Sciences

Holbrook Working

Food Research Institute, Stanford University

AMONG NATURAL SCIENTISTS there has been much discussion, both privately and in print, of the proposals for a National Science Foundation. Among social scientists there seems to have been too little such discussion. Certainly very little has appeared in print where social scientists generally could consider it. This paper is an attempt to raise for consideration some pertinent questions.

It seems appropriate first of all to try to get a broad general view of the similarities and differences between research in the natural sciences and research in the social sciences. Second, we may look more closely at some special characteristics of social science research and consider the extent and forms of present Federal support and of other support of such research. Finally, I shall venture a few tentative opinions that seem to me warranted.

The Social vs. the Natural Sciences

Let us set down in parallel columns the names of some of the social and natural sciences as an aid to reflection on comparisons:

Social	*Natural*
Economics	Biology
Political Science	Chemistry
Sociology	Physics
History	Taxonomy
Business Administration	Astronomy
Journalism	Geology
Psychology	Geography

At the head of each list appear, in alphabetical order, the three sciences which represent the three major divisions of their area of science. The appearance of taxonomy next in the natural science list may cause some raised eyebrows. It is there mainly for parallelism to emphasize a suggestion that history is largely the taxonomy of the social sciences. In history, the collection and ordering of social science facts has a more independent and unified existence as a branch within its own division of science than collection and ordering of facts has in the natural sciences. If one thinks, however, of taxonomy as primarily a branch of biology, its closest counterpart in the social sciences is statistics, meaning by statistics, census and other similar numerical data.

Statistics is omitted from both lists (which are frankly incomplete) partly because of the ambiguity of the term. In one sense statistics is a sort of taxonomy; in another sense, it is a branch of mathematics. The omission of mathematics also from the lists will not be taken as a slight, I hope, by any of my good mathematical friends. If mathematics is a science, as some have questioned, I am not sure whether it is social or natural.

Some may question whether there exists a science of business administration or of journalism. I shall insist only that their inclusion in the list will prove useful for my purposes.

Psychology and geography appear properly at the bottoms of the lists, as mavericks. At Stanford we class psychology as a social science, but the National Academy of Sciences says that it is a real science. Geography started out as a physical science but developed social tendencies, and at Stanford it has become one of the humanities.

The Bases of Science

It is useful to compare the natural and the social sciences with regard to their bases, and a diagram may be helpful (Fig. 1).

Science rests on description and analysis, and analysis rests in turn on observations in nature and on experiments. This generalization applies equally to natural science and to social science. If a diagram such as Fig. 1 were to be made quantitative, social science would perhaps deserve to be shown as resting more largely on description and less on analysis than natural science; and analysis in social science would have to be shown as resting more on observation in nature and less on experiment than in natural science.

From a paper presented before the Research Club of Stanford University, 6 March 1946.

Some unsympathetic observers of the social sciences might be inclined to depict part of economic analysis as hanging without visible support. But it must be obvious that any attempt to draw the diagram to scale would necessarily lead to a different diagram

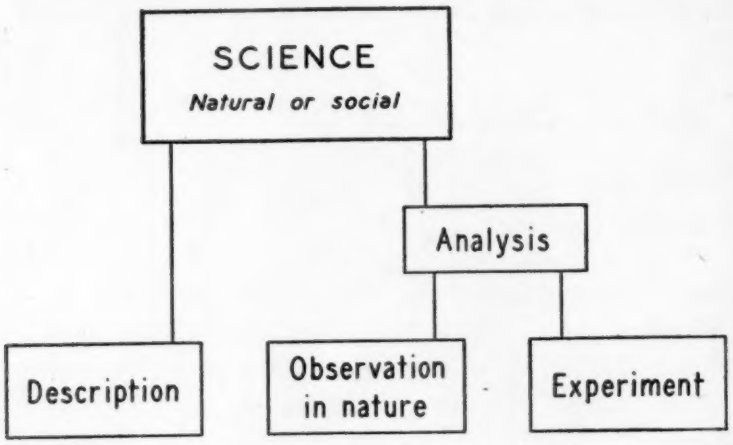

FIG. 1

for each science and even to quite different diagrams for different branches of any one science.

A further significant aspect of the bases of science is the nature of scientific analysis. The classical concept of the analytical process may be represented as in the upper part of Fig. 2.

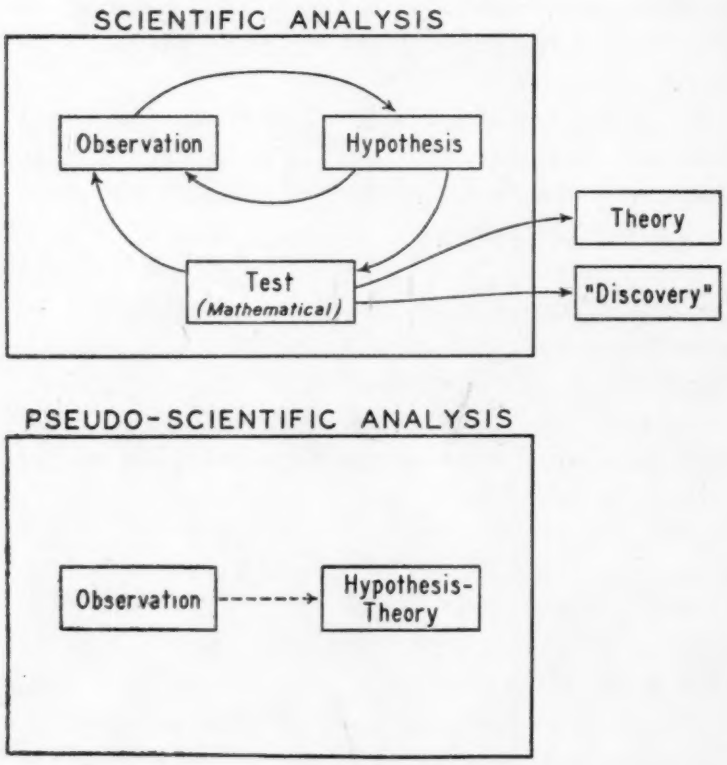

FIG. 2

Science proceeds in general from observations to an hypothesis and from an hypothesis to its test. The test of an hypothesis involves precise reasoning, which is mathematical in spirit and which may require elaborate formal mathematics. The first result of an hypothesis, however, may be a return to further observation, seeking additional data required for the indicated test. If the test fails, we return to consideration of the observational data and thence to a new hypothesis. If the test substantiates the hypothesis, there results a theory, or a conclusion which may be classed under some less pretentious name—I have said "discovery." In the diagram, boxes are provided outside the area representing scientific analysis to accommodate these results of successful tests, but these boxes are merely repositories for duplicate records of scientific results. There is no break in the circle of the analytical process: the results of a successful test flow back to augment the fund of observational data. The circle of the scientific process might indeed be represented better in three dimensions as an upward spiral.

The lower diagram in Fig. 2 attempts to represent the pseudoscientific process in which hypotheses are framed on a weak basis of observation and then treated uncritically as theories. The weakness of the observational basis may be inevitable, as in the early stages of any science; it may result from ignorance of the worker framing the hypothesis or from his inability to handle known facts effectively; or it may rest on more or less deliberate selection of facts that promise to support a desired hypothesis. When the choice of facts has been honest and reasonably thorough, the feature of the pseudoscientific process most deserving of criticism is its failure to distinguish between hypothesis and theory.

In economics, to cite one example from the social sciences, there has been, and still is, far too much of pseudoscience. The contrast drawn between science and pseudoscience must be recognized as a representation in black and white of a scene that in fact has many grays of varying shades. This variation is perhaps most conspicuous in the social sciences. One may find in economics examples of conclusions accepted as economic laws that are in fact only hypotheses founded on casual observation, known to be incomplete; one may find there conclusions founded on the most painstaking and rigorous search for facts and testing of hypotheses; and one may find conclusions of all degrees between.

Having spoken so frankly of the weaknesses of my own social science, perhaps it is permissible to say that I have thought I observed a tinge of gray in some writings in the natural sciences. I wonder if any science has been able to maintain a strict standard for distinction between hypothesis and theory.

If you are willing to entertain the idea that there may not be an entirely objective basis for distinction between hypothesis and theory, expression of a few thoughts on reasons for varying standards of acceptance for theories may be permitted. One may readily admit it as natural, if perhaps not fully justifiable

at standards for promotion from hypothesis to eory should be relatively lax in a new science, in a ience where experiment is impossible, or in a science here needed additional data, whether from observaon in nature or from experiment, may be extraordiarily difficult to come by. If so, then it is at least atural that the social sciences in general should be one sometimes to accept as theory what, by standds of the more rigorous natural sciences, should be garded as only hypothesis. Among the natural sciences themselves, one might expect to find some tenency toward differences in standards, as between tronomy or geology, which find experimentation ifficult or impossible, and physics or chemistry, where is relatively easy.

Sciences vary also with respect to the pressure nder which they stand to produce conclusions apicable to practical problems. Astronomy has felt ttle of such pressure, since not many people feel mpelled to reach conclusions involving the stars. eology and meteorology, scarcely more accessible to e experimental method than astronomy, have been bject to more pressure from people who want anwers to practical problems; and so they have been mewhat inclined, I suppose, to accept propositions adequately proven on evidence such as in astronomy ght be considered to warrant serious consideration ly as a major hypothesis. In medicine, if it may counted a science, and in the social sciences, the essure for conclusions is especially strong.

In short, much of what we count as knowledge at y time is not certainly true, but only probably true. e level of probability required before we say, "This so," rather than "This *may be* so," varies widely h circumstances. It is natural and proper that social sciences, hampered by difficulty of obtaining equate data, usually unable to make controlled exriments, and pressed to reach conclusions on vital ial problems, should change "may be" to "is" on s conclusive evidence than is required as a rule in natural sciences. To say this, however, is not to use the gross laxity of standards of proof which y sometimes be found in the social sciences nor to ss over the fact that in large areas still the social ences are scarcely to be called scientific in a strict se.

Experimentation in Social Science

t is often said that the social sciences, excepting chology, cannot be experimental. This is not true. e fact is rather that experiments in economics and itical science are quite possible, but must often be a grand scale and usually not well controlled.

We have been reading in the newspapers of an periment in the natural sciences on a staggering scale. Two billion dollars were spent on making a few atomic bombs. The book value of the ships which authorities were willing to have destroyed at Bikini was $400,000,000.

That experiment may be compared with one in economics in which the theories—or, more strictly, the hypotheses—of Karl Marx are being tested. The whole of one of the three most powerful of modern nations has been the subject of that experiment during a human generation, and the end is not yet.

Look at another example. Some 20 years ago the distinguished British economist, J. M. Keynes, advanced some hypotheses with regard to the effects of saving and spending on the national economy. A decade later the entire United States was the field of an experiment testing those hypotheses.

Lest an impression be left that all social experiments must be on a vast scale, some other examples should be added. The little city of Palo Alto has been a testing ground for many years, and rather painlessly, for the hypothesis that certain public utilities should be publicly operated. When an industrial establishment adopts a policy of submitting some questions of management to a labor-management committee, it is conducting a social experiment. Even the institution of a system of incentive pay for workers in a plant may be regarded as a social experiment.

At this point I can imagine an objection rising in the minds of some that many such examples as have been cited do not constitute true scientific experiments for lack of suitable controls. To such an objection two responses may be made: (1) that the good scientist scorns no pertinent experimental data if he has none better; and (2) that one of the grave needs of the social sciences is, in fact, to have social experiments so conducted as to afford more information than they usually do.

Social experiments require the cooperation of many people. If the Nation is involved, popular approval, or at least assent, must be obtained; a congressional committee, Congress itself, and the President must be persuaded; and sympathetic and competent administration must be provided. Even in a small social experiment within an industrial establishment, similar elements are involved in arranging and conducting the experiment. Through these circumstances, if no others, business administration and journalism play a large part in social science.

The nature of social experimentation makes it difficult in the social sciences to maintain a distinction between pure and applied science. In physics, devotion to pure science is refusal to be led into problems almost certainly of ephemeral interest, for the sake of concentrating on work that may indeed prove of no use at all but that may make a permanent contri-

bution to science. In economics, devotion to pure science is refusal to participate in the design and conduct of scientific experiments, and it is likely to mean also insulation from many facts pertinent to interpretation of the data of the science. The academic economist who, by choice or compulsion, keeps aloof from practical affairs, is likely to assure that he be also academic in the derogatory sense.

Whatever the choice of economists in the colleges and universities, the science of economics cannot keep aloof from current problems. Staffs of economists are employed by the major government departments concerned with economic questions—in the Federal Government, by Agriculture, Commerce, Interior, Labor, and State—and by numerous permanent and temporary agencies, such as the Commodity Exchange Administration, the Federal Reserve System, the Interstate Commerce Commission, the Tariff Commission, the Board of Economic Warfare, the War Production Board, and numerous others. Economists are employed by banks, brokerage houses, manufacturing establishments, great retail stores, and trade associations. Among the economists so employed are some of the highest standing in the profession. Some are working with great freedom on economic problems of the first importance. They work with facilities superior in important respects to those generally available to the academic economist and in close touch with the pertinent facts of their science. Many, of course, are mere interpreters of economic knowledge in relation to specific problems of application, but among them are some of the chief architects and builders of the science of economics as it stands today and, perhaps even more, as it will stand tomorrow. To them, economics owes much of its progress in the last 50 years.

Economics may stand somewhat apart from political science and sociology in the degree to which its advance has come to depend on workers in government service and in private employment instead of on those in universities and other institutions of learning, but it is not, I believe, in a fundamentally different position. Speaking of government support of research in the basic social sciences, we must recognize that government, and especially the Federal Government, is already supporting such research on a grand scale. The question is not whether government should support research in the social sciences or even whether it should increase its support of the social sciences. It will do that also. The question may better be put: Should government channel much of its support of research in the social sciences through the colleges and universities and other independent institutions, decentralizing it and increasing its freedom from restraints of special interests and from political pressures?

Because research in the social sciences so often has a clear or apparent direct bearing on the interests of groups of people that are influential either because of their numbers or their position, social science is more subject than natural science to restrictions on freedom of research. Such restrictions occur, indeed, in the natural sciences. I have heard the head of a Department of Dairy Industry in a great university report privately results of research on comparative nutritive values of butter and margarine which he felt it inexpedient to publish. Medical and biological research has to fight a recurring battle with professed lovers of animals who object to their use in experimentation. But restraints on freedom of research and publication in the social sciences are much greater, and with them goes much pressure to support favored views.

These restraints and pressures are probably nowhere to be escaped, but they differ in different types of institutions and in different regions. Governmental agencies are subject to one set of restraints and pressures, which may change to some extent with the situation in party politics. Business-supported research is often subject to more obvious warping in direction and in conclusions. In state-supported educational institutions the situation is much as it is in government, though with large variations from state to state. Even the large endowed universities and independent research organizations are not without their pressures and restraints. In this situation, safety for social science research seems to lie in its diffusion, along with all possible efforts to maintain freedom and adherence to sound scientific and scholarly standards.

The Data of Social Science

A great part of the work of collecting the data of social science is now in government hands and largely in the hands of the Federal Government. It must be because of the magnitude of the task. One thinks immediately of the Bureau of the Census as the most important collector of statistical data. A convenient quick view of much of the quantitative data of the social sciences may be had by a glance at one of the annual volumes of the *Statistical abstract of the United States,* which asserts appropriately that it "presents in one convenient volume important summary statistics on the industrial, social, political, and economic organization of the United States, and includes a representative selection from most important statistical publications." It is a handy little volume of 1,000 closely printed pages. Included is a list of statistical tables according to sources, in which credit for data is given to 66 Federal Government agencies

in addition to the Bureau of the Census. Next in the list are one state agency, and 37 nongovernmental agencies, from the American Bankers Association to the Western Union Telegraph Company. Of the 37, all are commercial organizations except two: the American Medical Association and the National Bureau of Economic Research. Though the nongovernmental agencies listed comprise over one-third of the total number, they provide only a small fraction of the total mass of data.

While the Federal Government is now supporting and administering, apart from the collection of data, a substantial portion of social science research in the United States, it is the mainstay of such research in the provision of basic statistical information for the social sciences.

There is perhaps no good reason why the more or less routine collection of statistical data which may reasonably be supported from Federal funds should be administered by other agencies, and there are good reasons for centralizing responsibility for such collection. It is important, however, that the Federal agencies collecting data should be responsive to the needs and wishes of independent research workers and groups of workers, readily giving consideration to proposed changes in practice.

Some of the governmental collection agencies have provided for advisory committees through which nongovernmental social scientists are represented and given a voice in the planning of data collection. Another avenue through which nongovernmental interests may gain a hearing is the important and very useful Division of Statistical Standards of the Bureau of the Budget, which exercises general supervision over collection of statistical data by all branches of the Federal Government, is very capably staffed, and takes a broad view of the functions of Federal agencies in collection of statistics. It might not be inappropriate, however, to have more specific and formal recognition than now exists of the function of governmental data collection as a service for social scientists generally.

If routine collection of data should be largely in government hands, it does not necessarily follow that collection of data for special research purposes should likewise be so concentrated. A new governmental activity is hard to get started. One reason that it should be so is that it may also be hard to stop. Research needs to be flexible. It needs to be implemented by a large measure of freedom for men with ideas to act, without too much interference from minor administrative officials, whose sense of importance may exceed their capacity for wise supervision of scientific research. Research does not fit comfortably into the pattern of governmental administrative routine.

Collection of statistical data for special research purposes is a continually recurring need of the social sciences, corresponding in many respects to the need for performing experiments in the natural sciences. Facilities for such collection of special data should be available to workers in the social sciences, so far as possible, with only such restrictions as have been found appropriate on the use of facilities for experimentation in the natural sciences. A chemist in a university would labor under a handicap if he had to arrange that any large experiment from which he needed data be conducted in a government laboratory in Washington.

Association Affairs

Call for Papers

113th Meeting, Boston, 26-31 December 1946

Persons desiring to present papers at the Boston Meeting of the AAAS and its affiliated societies are requested to notify at an early date the secretaries of the sections and societies before which they wish to report their work. The secretaries will be aided in their acceptance of papers if each speaker will enclose with the notice an abstract describing the purpose of the investigation, the nature of the results obtained, and the relations of the results to earlier investigations. It is not necessary that those presenting papers be members of the Association.

Copy for the *General Program* of the meeting is due in the Washington office of the Association by 21 October; titles of papers should be submitted without delay to the secretaries in order that those accepted may be included in the printed program.

SECTION SECRETARIES

Mathematics—Prof. Raymond W. Brink, University of Minnesota, Minneapolis, Minnesota.

Physics—Dr. Joseph C. Boyce, New York University, New York City.

Chemistry—Office of the Administrative Secretary, American Association for the Advancement of Science, Smithsonian Institution Building, Washington 25, D. C.

Astronomy—Dr. Charles C. Wylie, State University of Iowa, Iowa City, Iowa.

Geology and Geography—Dr. George W. White, The Ohio State University, Columbus, Ohio.

Zoological Sciences—Dr. J. William Buchanan, Northwestern University, Evanston, Illinois.

Botanical Sciences—Prof. George W. Martin, State University of Iowa, Iowa City, Iowa.

Anthropology—Dr. Marian W. Smith, Columbia University, New York City.

Psychology—Dr. Harold E. Burtt, The Ohio State University, Columbus, Ohio. (See special announcement below.)

Social and Economic Sciences—Dr. Bruce L. Melvin, 1355 Ingraham St., N.W., Washington, D. C.

History and Philosophy of Science—Dr. Raymond J. Seeger, Wetherhill Rd., Washington 16, D. C.

Engineering—Prof. Frank D. Carvin, Newark College of Engineering, Newark, New Jersey.

Medical Sciences—Dr. Malcolm Soule, University of Michigan, Ann Arbor, Michigan.

Subsection on Dentistry—Dr. Isaac Schour, University of Illinois College of Dentistry, Chicago, Illinois.

Subsection on Pharmacy—Dr. Glenn L. Jenkins, Purdue University School of Pharmacy, Lafayette, Indiana.

Agriculture—Prof. E. E. DeTurk, University of Illinois, Urbana, Illinois.

Education—Prof. D. A. Worcester, University of Nebraska, Lincoln, Nebraska.

Special Notices

Members of Section I (Psychology) wishing to present papers should send abstracts to the secretary, Harold E. Burtt, Department of Psychology, The Ohio State University, Columbus 10, Ohio. Abstracts, which should be in triplicate and not over 200 words, will not be considered if they are received after 15 September. If slides, chart, or blackboard are necessary, a statement to that effect should appear at the end of the abstract. In the case of slides, please specify whether they are standard or 2×2 size. Moving pictures will not be shown in conjunction with the papers, but they may be scheduled in connection with Science Exhibition.

A motion picture theater will be set up in the Science Exhibition area at the Frst Corps Cadet Armory. The Committee on Exhibits is interested in receiving applications from scientists who have taken motion pictures of original research in the laboratory or in the field for exhibition. Films concerned with scientific research or scientific supplies prepared by commercial organizations will be considered. Equipment will also be available for showing slides. Applications for a place on the projection schedule should be obtained from: Theo. J. Christensen, American Association for the Advancement of Science, Massachusetts and Nebraska Avenues, N.W., Washington 16, D. C.

Judges Named for AAAS-George Westinghouse Science Writing Award

The Managing Committee of the AAAS-George Westinghouse Science Writing Award has announced the names of the seven judges who will select the winner for the year 1946. Morris Meister, director of the National Science Teachers Association and principal of the Bronx High School of Science, is chairman. Serving with Dr. Meister are two newspaper editors: Wilbur Forrest, of the *New York Herald Tribune* and president of the American Society of Newspaper Editors, and W. S. Gilmore, of the *Detroit News* and past president of ASNE. The AAAS is represented by James B. Conant and Anton J. Carlson. The two additional judges representing the public are Miss Sally Butler, president of the National Federation of Business and Professional Women's Clubs, and Senator Elbert D. Thomas of Utah, chairman of the Senate Military Affairs Committee and a member of the AAAS.

The Science Writing Award consists of a $1,000 prize to the writer of the newspaper science story which wins the approval of the judges. A certificate of merit goes to the newspaper. The funds for this purpose were provided by the Westinghouse Educational Foundation and are administered by the AAAS through a committee. Entry blanks and rules governing the competition may be secured from W. L. Valentine, chairman of the Committee, Massachusetts and Nebraska Avenues, N.W., Washington 16, D. C.

Technical Papers

Species Density Analysis of Silicate Glass Structure[1]

JOSEPH S. LUKESH

Mineralogical Laboratory, Massachusetts Institute of Technology

The dependence of certain physical properties of silicate glasses on the ratio of metal to oxygen atoms has been discussed by Huggins (*1*). Considering the variation in the volume per gram atom of oxygen with composition, the latter expressed as ratio of silicon to oxygen atoms, he was able to demonstrate that a series of linear relations exists. The volume varies as straight lines between the ratios .500 and .435, .435 and .400, .400 and .364, and .364 and .333. With the exception of that at .435, these ratios correspond to the compositions of well-known silicate structural types, listed in Table 1. Huggins explained the breaks in the curve of volume per gram atom of oxygen as indicating that the structure of the glass is influenced by the number of oxygen atoms shared, on the average,

TABLE 1

SILICON-OXYGEN RATIOS OF SILICATE STRUCTURAL TYPES

Ratio	Structural Type
.500	Quartz, tridymite, cristobalite
.435	None
.400	Mica
.364	Amphibole
.333	Pyroxene

by each silicon-oxygen tetrahedron just as are the structures of the crystalline silicates. At the ratio .400, for instance, each tetrahedron shares three of its oxygen atoms with adjacent tetrahedrons. Similarly, at .364, half of the tetrahedrons share three and half share two oxygens. Between these two specific compositions, the physical properties of silicate glasses are additive.

It is immediately apparent that any method of treating the data on specific volume can be applied to its reciprocally related function, specific gravity. As will appear later, there are a number of advantages, quite apart from ease of computation, in favor of doing so. In Fig. 1, the densities of a series of sodium silicate glasses (*2*) have been plotted against the ratio of silicon to oxygen atoms. It can be seen that variations in the density can, indeed, be represented by several straight lines, with changes in slope at the values previously listed. (In the example given in Fig. 1, the particular glass series chosen did not include compositions high enough in sodium oxide to reveal the break at .333.)

[1] This investigation was supported by the Owens-Illinois Glass Company. The writer is also indebted to M. J. Buerger for much helpful advice.

THE SPECIES DENSITY ANALYSIS

Curves such as that shown in Fig. 1 are of limited usefulness, since all atomic species are lumped together, and it is impossible to deduce the packing characteristics of the various species and the relations between the framework and the metallic atoms. If, however, one separates the total density into the contributions of each individual species, a great deal of

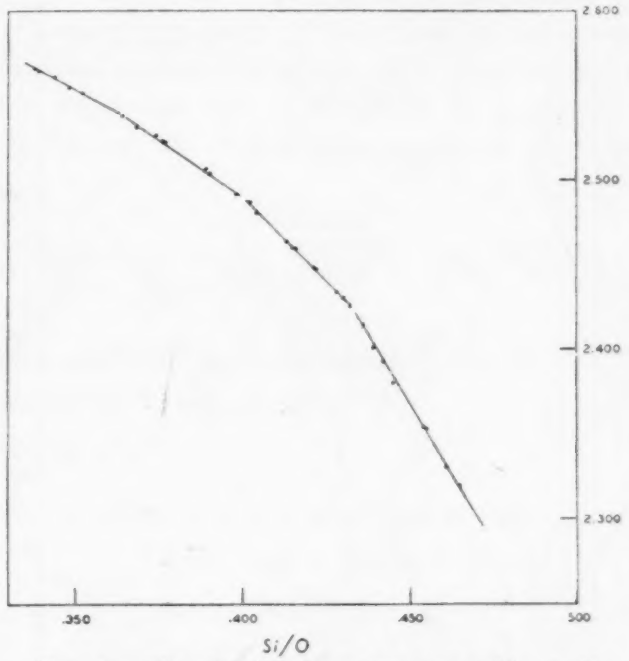

FIG. 1. The density in grams per cubic centimeter of sodium silicate glass as a function of the silicon to oxygen ratio.

information can be obtained. The separation can be accomplished merely by multiplying the total density by the weight per cent of each species. The resulting values, which may be called the "species densities," will, when plotted as a function of the silicon to oxygen ratio, illustrate how the packing of the various species is influenced by the changes in linkage of the tetrahedrons.

The validity of the species-density concept can be shown quite simply. Obviously, the total mass in a unit volume is equal to the sum of the masses of the individual components. Assume a compound, AX, which has a specific gravity of 3.000 (or a density of 3.000 grams/cc.) and elements A and X having atomic weights of 60 and 40, respectively. In 100 cc. of this compound there are 300 grams. In each 100 grams of compound AX there are 60 grams of A

and 40 grams of X. The density contribution of species A is equal to the weight fraction of A times the total density, or 60/100 of 3.000, which is equal to 1.800. Similarly, that of X will be 1.200. The sum, of course, is equal to the total density.

A convenient form for computing species densities in silicate glasses is shown in Table 2. For simplicity, all computations are based on 100 grams of glass. The mass of each species in grams/100 grams of the glass (third, fourth, and fifth columns of Table 2) is, therefore, also the weight per cent of that species, which is the figure by which the total density must be multiplied to obtain the species density. The example chosen is a glass in the two-component sodium silicate system. Additional columns may be added for systems containing more than two components.

TABLE 2

SPECIES DENSITY COMPUTATION

Mass					Gram Atoms			Density			Ratio
Na_2O	SiO_2	Na	Si	O	Na	Si	O	Total	Na	Si,O	Si/O
27.85	72.15	20.66	33.71	45.63	.898	1.204	2.852	2.4488	.5060	1.9428	.421

THE SODIUM SILICATE SYSTEM

When the total densities plotted in Fig. 1 are broken down into species densities, and the contributions of sodium and of the silicon-oxygen framework are plotted against the ratio of silicon to oxygen, a rather striking picture results. Fig. 2 shows that fraction of the total density which is attributable to the silicon-oxygen framework, and Fig. 3, that which is due to the sodium atoms. It is of particular importance to note that the data concerning the framework (Fig. 2) can be represented by only two straight lines. The one break which appears is at the ratio for which no crystalline silicate type is known. (Actually, this break appears to be closer to .433 than .435, as reported by Huggins.) The contributions of sodium (Fig. 3), on the other hand, show all of the breaks seen in the total density curve.

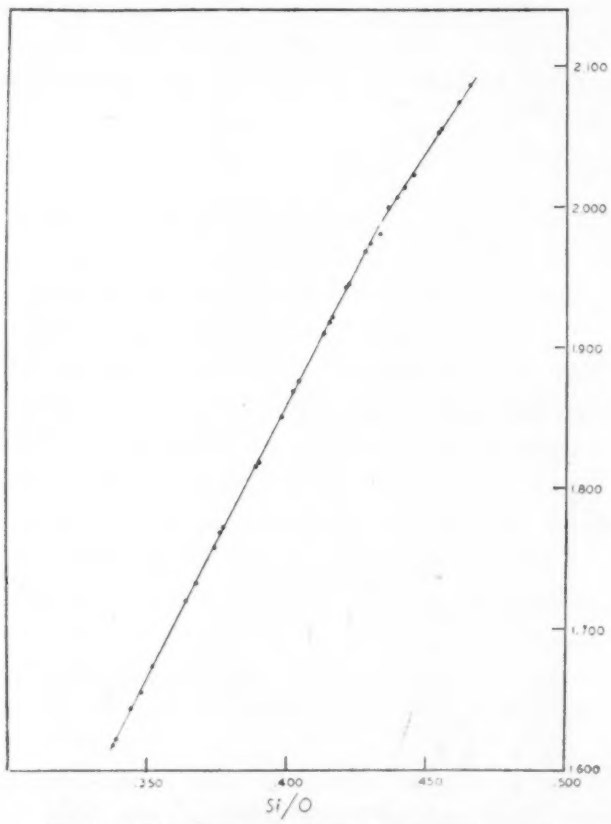

FIG. 2. The density in grams per cubic centimeter of the silicon-oxygen framework in sodium silicate glass as a function of the silicon to oxygen ratio.

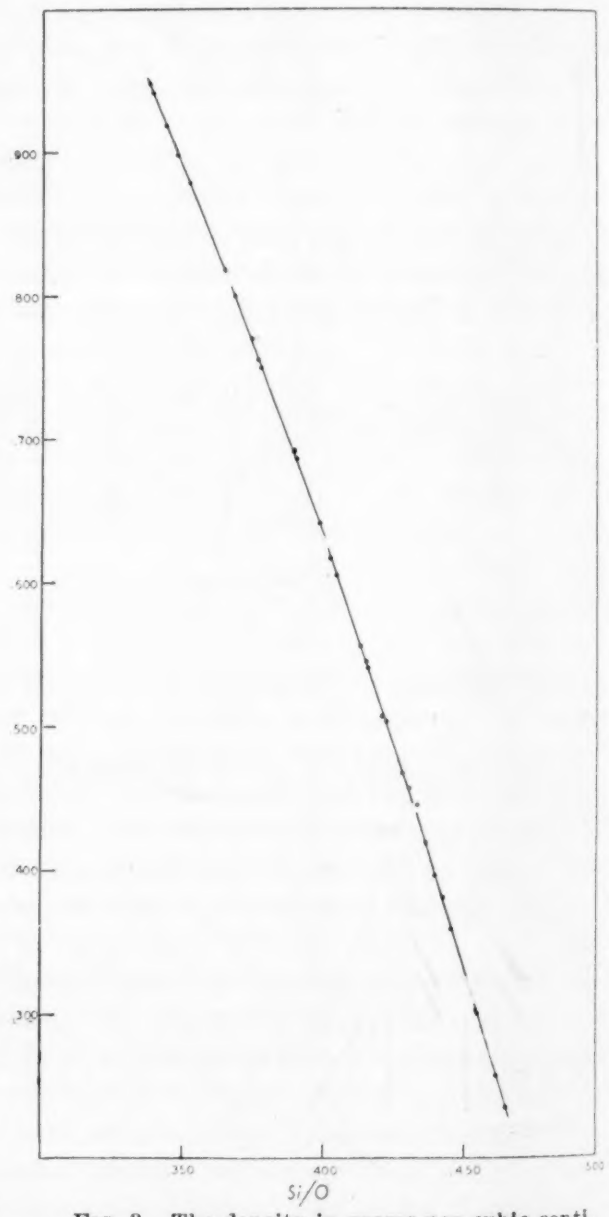

FIG. 3. The density in grams per cubic centimeter of sodium in sodium silicate glass as a function of the silicon to oxygen ratio.

A full explanation of the meaning of the difference

in the two curves and of the structural relations that can be deduced from them will be deferred until a later date when the several alkali silicate systems can be covered. It is sufficient for the purposes of this discussion to point out that the break at .433 is most probably related to saturation of the cristobalite-like structure of silicate glass with sodium atoms. Above this ratio, the introduction of sodium does not cause much expansion of the framework, since there is sufficient void space to accommodate the additional atoms. Most of the lowering of framework density can be accounted for by the removal of silicon atoms. Below the critical ratio, however, it is necessary for the whole structure to expand as additional sodiums are added, because the voids in the framework are full. Changes in the numbers of oxygen atoms shared by each tetrahedron apparently produce no changes in the rate of change of the framework density. Changes in linkage do, on the other hand, influence the packing of sodium; hence the breaks in the species density curve of sodium.

Structure-Phase Diagrams

The curves illustrated in Figs. 1–3 are essentially phase diagrams in that they reveal compositional regions where certain structural characteristics are predominant. The word "phase" is not used in the restricted sense that it has in physical chemistry. To avoid confusion, it is proposed to refer to the compositional regions as "structure-phases." From Fig. 2 one may deduce that the framework of sodium silicate glasses has two structure-phases, one above and one below the ratio .433. The latter is further subdivided into four subphases which are characterized by different packing laws of the sodium atoms. Similarly, it has been found in the potassium silicate system that the framework has only one structure-phase and that this is divided into a number of subphases.

The concept of structure-phases can be extended to three component systems, such as sodium potassium silicate, as well as two component ones. In this case it is not possible to plot the species density as a function of the silicon to oxygen ratio, since two abscissa are required, each of which is a measure of the effect of one metallic atom species. The ratios used for such three-dimensional diagrams are the ratios of each metal to oxygen. Actually, Figs. 1–3 might well have been plotted against the sodium to oxygen ratio. The resulting curves would have had the same appearance as when plotted against the silicon to oxygen ratio, since the two ratios are linearly related by the equation $Na/O = 2 - 4Si/O$.

The construction of species density diagrams can be accomplished with a minimum of experimental data, a fact which is of considerable value in the study of glass systems. For the two component systems, each phase is represented by a straight line, and it is only necessary to determine the slope of the line. Given some background of knowledge of the system, two points may suffice for each phase. For three component systems, the phases are represented by planes, and in many cases three points may be sufficient.

Applications of the Species Density Analysis

Although the potential uses of structure-phase diagrams have not, as yet, been explored fully, it can be anticipated that applications will be found not only in the study of glass systems but also in such fields as mineralogy. Solid solutions in which one metallic species is progressively replaced by another might be analyzed for information as to the effect of size and charge of various species on structure. An interesting application is in systems containing atoms which take the silicon position at the center of the oxygen tetrahedron, as does aluminum. The structure in such cases is dependent, not on the silicon to oxygen ratio, but rather, on the silicon plus aluminum to oxygen ratio.

References

1. Huggins, M. L. *J. opt. Soc. Amer.*, 1940, **30**, 420.
2. Morey, G. W. *The properties of glass.* New York: Reinhold, 1938. P. 237.

Mechanism of Spontaneous Cure in Puberty of Ringworm of the Scalp[1]

Stephen Rothman and Adelaide M. Smiljanic
University of Chicago
Alfred W. Weitkamp
Standard Oil Company (Indiana)

Since 1943 ringworm of the scalp hair caused by the fungus *Microsporon audouini* has been endemic among school children in numerous large cities of the United States (*1*). It has been known for more than 50 years (*3*) that although this infection is distressingly persistent during early childhood, it clears up spontaneously with oncoming adolescence. The scalp hair of adults is immune throughout life. For therapeutic purposes sex hormones have been administered to children with this disease in order to simulate pubertal conditions, but practicable doses have not been effective. From the therapeutic point of view it therefore seemed more promising to investigate the local changes on the scalp following puberty and to find out what makes the scalps of adults nonsusceptible to *M. audouini* infections. Such investigations were started a year and a half ago in the Division of

[1] This work was aided by a grant from Wallace and Tiernan Products, Inc., Belleville, New Jersey.

Dermatology of the University of Chicago. It was learned (*2*) that there are ether-extractable substances on human hair that inhibit the growth of *M. audouini* on culture media. The total ether extract (hair fat) of adults was found to be five times as effective as the hair fat of children. This provided a ready explanation for the immunity of adults. Further confirmation was provided by the fact that 10 times higher concentrations of hair fat were required to inhibit the growth of certain other pathogenic fungi, such as *Trichophyton gypseum, Achorion schoenleinii,* and *M. lanosum,* to which the hair of adults is not immune.

In a search for the active fungistatic principle of hair fat it was found (*2*) that the neutral portion was quite inactive but that the free acidic components were strongly inhibitory. Further fractionation of the free fatty acids by steam distillation yielded a few per cent of a very potent material in the distillate, leaving the bulk of the free fatty acids as relatively inert residue. Acids above C_{12} are practically nonvolatile with steam and have little inhibitory power. Vacuum distillation of the steam distillate yielded fractions, the activity of which decreased as the boiling point increased. The most active fractions, obtained in vanishingly small amounts, appeared on the basis of elementary analyses, molecular weight estimations, and qualitative reactions to be saturated monobasic acids in the range of C_7 to C_{11}. When added to Sabouraud's agar medium in graded amounts, these fractions completely inhibited the growth of *M. audouini* at concentrations of 0.0002 to 0.0005 per cent.

Experiments with all of the available monobasic aliphatic acids revealed that maximum fungistatic and fungicidal activity on *M. audouini* is possessed by the straight-chained saturated monobasic C_7, C_9, C_{11}, and C_{13} acids. These acids are the only ones which we have found to be comparable in activity to the most active fractions of hair fat.

Recently it has been possible to collect 45 kg. of adult hair, representing over 10,000 haircuts. Ether extraction was carried out in a 50-gallon tank and yielded 230 grams of free fatty acids along with several kilograms of neutral substances.

The free fatty acids were separated by careful fractional distillation of their methyl esters in a 100-plate still, operated at 2-mm. pressure. Chain lengths ranged from 7 to 22 carbon atoms. The C_7 to C_{11} fraction amounted to 1 per cent of the total and was refractionated in the presence of a mineral oil diluent in order to achieve more complete separation. Prominent in this fraction is pelargonic acid, the C_9 saturated normal aliphatic acid. Its identity has been confirmed by the melting point and nitrogen content of its amide. Not all of the component acids have been identified. However, sufficient is known with certainty to report the presence of saturated and unsaturated normal aliphatic acids having both odd and even numbers of carbon atoms. Human hair fat appears to be unique among fatty materials, in that a whole series of normal aliphatic acids having odd numbers of carbon atoms is present in significant amount. The isolated acids containing odd numbers of carbon atoms are identical in fungistatic efficiency with the corresponding acids obtained from other sources.

Therapeutic experiments on hospitalized children with ringworm of the scalp were started early in this experimental work. Total hair fat, low-boiling fatty acid fractions from hair fat, pelargonic acid, and its equally fungicidal sodium salt were all applied in a variety of ways: by simple massage; by fixing the material to the lesions with air-tight dressings; in concentrated form and in varying dilutions; in combination with wetting agents; and by introduction of sodium pelargonate and sodium undecylenate into the hair follicles by means of galvanic current.

Unfortunately, no curative effect was obtained with any of our methods. *In vitro* experiments have shown the cause for these negative results: Neither the fatty acids nor their salts penetrate the keratin material of the hair, and therefore they are unable to exert their action on spores inside the hair. It seemed possible that the combination of a fungicidal fatty acid salt with a mild keratolytic agent such as sodium thioglycolate would facilitate penetration of the hair shaft, but the results so far have not been encouraging.

The failure of our therapeutic experiments led to the conclusion that, in nature, when the ringworm is healed during puberty, the fatty acids exert their fungicidal action by some means other than penetration of the hair. The fat, after it has been formed in the sebaceous glands, diffuses into the follicular canal, to the surface of the hair, and to the surface of the scalp. With oncoming adolescence the active fatty acids sterilize these pathways but not the hair shaft. However, when the infected hair falls out and a new hair is formed in the same follicle, this new hair is not infected because the inner surface of the follicle is sterilized. This situation results in cure when (after many months) all the infected hair has fallen out in the course of natural shedding. Correspondingly, the spontaneous cure in puberty is a rather slow process. Among our patients, children far advanced in puberty (girls menstruating for many months, boys with well-developed pubic hair) still had infected hairs. Although the mechanism of spontaneous cure seems to be well understood, a way to utilize this mechanism for a rapid cure has not been found, particularly because the generation change of hair in small children is slower than in puberty.

If a ringworm lesion is treated locally with pelargonic acid or other fungicidal agent, the spread of the lesion is checked immediately because the spread from one hair to another via follicular wall to surface of scalp, and from there into the inner follicular wall of the next hair and into the hair shaft, is inhibited. Hence, it can be concluded that local treatment of exposed but noninfected children, in schools, orphanages, and other places where children congregate in numbers, will effectively check the spread of epidemics. Whether such prevention is practicable has not yet been investigated.

Summary. With onset of puberty, the sebaceous glands of the scalp start to secrete a sebum which contains, in higher concentration than before, low-boiling saturated fatty acids with selective fungistatic and fungicidal action on *M. audouini.* Highly active normal aliphatic monobasic acids having odd numbers of carbon atoms, including pelargonic acid, have been isolated from hair fat of adults. The "adult type" of hair fat does not kill the fungus spores within the hair but prevents infection of the new hair following the old infected hair in the process of shedding.

Detailed reports are to be published elsewhere.

References

1. Rothman, S. *Hygeia,* 1945, **23**, 436.
2. Rothman, S., Smiljanic, A. M., and Shapiro, A. L. *Proc. Soc. Biol. Med.,* 1946, **60**, 394.
3. Sabouraud, S. *Ann. Inst. Pasteur,* 1895, **9**, 87.

Inhibition of the Catalyzed Thermal Decomposition of DDT

Francis A. Gunther and Lois R. Tow

University of California Citrus Experiment Station, Riverside

Laboratory (*2, 3, 4, 14*) and field (*2, 11*) studies indicate that insecticidal preparations containing DDT may decompose thermally unless specifically protected from exposure to even moderately high temperatures. Evidence to the contrary has been published (*1, 12, 13*). Under field conditions, however, DDT as such may disappear so rapidly as to preclude mere evaporation (*5*) from consideration, particularly when a considerable residue of the almost noninsecticidal dehydrohalogenation product is demonstrable (*10*). The iron-catalyzed dehydrohalogenation of DDT has been amply verified (*1, 2, 6–9*). Because most technical DDT contains traces of iron or iron salts by the time it reaches the surface being treated, it seemed worth while to present this brief preliminary report upon two substanecs found to inhibit the iron-catalyzed thermal decomposition of DDT. The full details underlying this study will be reported elsewhere.

Picolinic acid (GD 2100)[1] and salicylal-aminoguanidine (GD 2101)[1] are the two inhibitory substances. When 1.5 per cent of ferric nitrate, 2 per cent of either inhibitor, and 96.5 per cent of iron-free technical DDT of setting point 90.1° C. were mixed intimately and heated 24 hours at 110–120° C., the resulting dehydrohalogenation was negligible (1.0 per cent for GD 2100; 2.5 per cent for GD 2101). Without inhibitor, the resulting dehydrohalogenation was complete under the same conditions. In Fig. 1 is

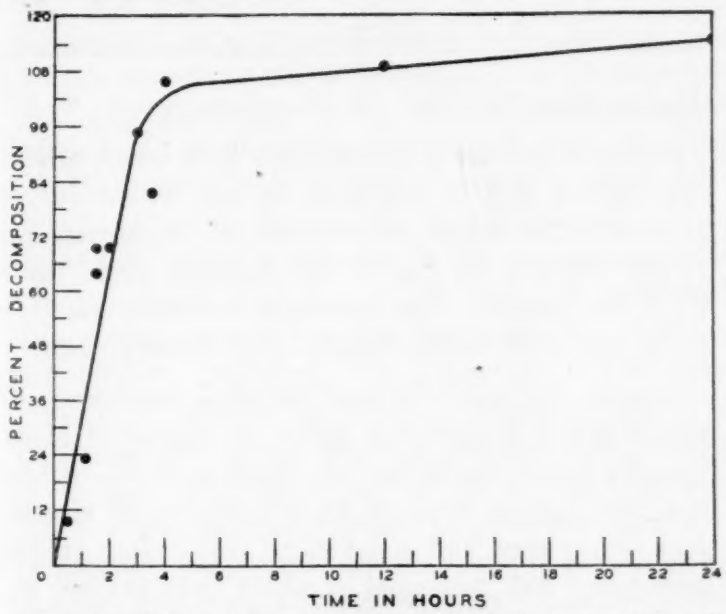

Fig. 1. Rate of decomposition (dehydrohalogenation) of technical DDT plus ferric ion as dehydrohalogenation catalyst at 110–120° C.

shown a plot of the rate of thermal dehydrohalogenation of the technical DDT plus ferric ion. The rate of dehydrohalogenation curves for similar mixtures plus the inhibitors, within the concentration range 2–20 per cent, were so nearly superimposable horizontal straight lines that they could not be plotted satisfactorily. Still lower concentrations of inhibitor may be equally effective, although this possibility has not been investigated.

That the inhibition of the iron-catalyzed thermal decomposition of DDT is not attributable solely to mere buffer action is evinced by extensive dehydrohalogenation in the presence both of calcium dihydrogen phosphate and of sodium carbonate. The effects of sunlight and weathering upon these two organic inhibitors are under investigation in field tests and will be reported elsewhere.

References

1. Balaban, I. E., and Sutcliffe, F. K. *Nature, Lond.,* 1945, **155**, 755.
2. Chisholm, R. D. *U. S. Dept. Agric. Bull., E–643,* March 1945.
3. Cutkomp, L. K. Abstract of manuscript for publication, released by Committee on Medical Research and dated 19 April 1946.

[1] Covered by U. S. Patent 2,363,778 as metal deactivators and issued to C. J. Pedersen. Samples of these compounds were very generously supplied by H. C. Stecker, of E. I. du Pont de Nemours and Company, Wilmington, Delaware.

4. FAY, R. W., SIMMONS, S. W., and CLAPP, J. M. *Publ. Hlth Rep.*, 1945, Suppl. No. 186, 21.
5. FLECK, E. E. *J. econ. Entomol.*, 1945, **37**, 853.
6. FLECK, E. E., and HALLER, H. L. *J. Amer. chem. Soc.*, 1944, **66**, 2095.
7. FLECK, E. E., and HALLER, H. L. *Ind. eng. Chem.*, 1945, **37**, 403.
8. FLECK, E. E., and HALLER, H. L. *J. Amer. chem. Soc.*, 1946, **68**, 142.
9. GOODHUE, L. D., and BALLINGER, W. R. *Ind. eng. Chem.* (Anal. ed.), 1946, **18**, 131.
10. GUNTHER, F. A. Manuscript in preparation.
11. GUNTHER, F. A., LINDGREN, D. L., LADUE, J. P., and ELLIOT, M. I. Data on file at the Citrus Experiment Station, Riverside. Presented in part on 6 December 1945 before a national meeting of the American Association of Economic Entomologists in Dallas, Texas. (These and other decomposition data will be published elsewhere.)
12. MARTIN, H., and WAIN, R. L. *J. roy. hort. Soc.*, 1944, **69**, 368.
13. SWEETMAN, H. L. *Soap sanit. Chem.*, 1945, **21**, 141.
14. ———. *J. sci. ind. Res.* (India), 1945, **4**, 73.

News and Notes

About People

James B. Conant is among those upon whom honorary degrees will be conferred by the University of London in November. Others are: E. D. Adrian, Sir Henry Dale, R. A. Fisher, Sir Geoffrey Taylor, and C. T. R. Wilson. The ceremony will take place in connection with the celebration of Founders' Day.

Joseph Erlanger became emeritus professor of physiology at Washington University School of Medicine, St. Louis, on 1 July. At Washington University over 30 years of work on various aspects of circulatory physiology and a series of researches on the mechanism and treatment of shock were carried out in Dr. Erlanger's laboratories. His work led to the Nobel Prize in Medicine in 1944.

H. K. Wilson, head of the Department of Agronomy, The Pennsylvania State College, has been appointed vice-dean and director of Resident Instruction. At present he is filling both positions.

R. A. Fisher, professor of genetics at the University of Cambridge, returned to England on 16 August after spending two months as visiting professor at North Carolina State College, Raleigh. Formerly Dr. Fisher was chief statistician at the Rothamsted Experiment Station, Harpenden, Herts, England, and Galton professor of eugenics at University College, University of London.

Albert M. Stone, formerly with the Radiation Laboratory, Massachusetts Institute of Technology, has been appointed as a physicist in the London office of the Office of Naval Research. Dr. Stone will serve in a liaison capacity between European and American physicists. A former assistant professor of physics at Montana State College, Dr. Stone has most recently served on the Editorial Board for the Radiation Laboratory series of technical monographs.

George H. Ashley, chief of the Pennsylvania Bureau of Topographic and Geologic Survey, will retire on 31 August at the age of 80. He will be succeeded for the last quarter of the year by his associate, Ralph W. Stone, who will himself retire in December at the age of 70.

Arthur G. Kevorkian is leaving on 30 August for Cienfuegos, Cuba, to become director of the Atkins Garden and Research Laboratory and lecturer on tropical botany.

F. W. Aston, Trinity College, Cambridge, who died 20 November, left 1,000 pounds and his scientific apparatus to the Cavendish Laboratories; 4,000 pounds to the president and Council of the Royal Society for general purposes; 1,000 pounds each to Birmingham University, the British Association for the Advancement of Science, and the Cambridge Preservation Society; and 500 pounds each to the Cambridge Philosophical Society, the Fitzwilliams Museum, and the Malvern College, according to the *Times,* London.

Roger Adams, department of chemistry, University of Illinois, member of the *Science* Policy Committee, and chairman of the American Chemical Society Board of Directors, will receive the Priestley Medal 11 September at the Society's 110th meeting in Chicago. The Priestley Medal, established in 1922, is granted for "distinguished services to chemistry" by the society and has been won, among others, by James B. Conant, Thomas Midgley, Jr., William A. Noyes, also of Illinois, Charles L. Parsons, and former President Ira Remsen of Johns Hopkins.

This honor is the fourth occasion upon which Dr. Adams has been cited this year. He earlier was presented with the Davy Medal of the Royal Society, London, the Theodore William Richards Medal of the Northeastern Section of the Chemical Society, and was selected to give the first Remsen Memorial Lecture at Johns Hopkins University.

Announcements

Recent appointments to the faculty of the University of Michigan have been announced as follows: J. Speed Rogers will become director of the Museum of Zoology and professor in the Department, effective 1 January 1947. Dr. Rogers has been on the faculty

at the University of Florida since 1919. J. Emerson Kempf, now assistant professor of bacteriology at the University, has been made director of the Pasteur Institute succeeding Herbert W. Emerson, who has been granted sick leave for the year 1946–47, at the end of which time he will retire.

Philip M. Morse, professor of physics at Massachusetts Institute of Technology and wartime consultant on scientific projects to the Navy Department, has been named as director of Scientific Research for the Associated Universities, Inc., which will establish the new atomic research center at Camp Upton, Long Island. The announcement was made by Edward Reynolds, of Harvard University, president of the new organization.

Nine educational institutions of the East have cooperated to form Associated Universities, Inc., which will operate the research center at Camp Upton under government contract. The camp has been transferred from surplus to the Manhattan Engineer District for the purpose. The universities comprising the group are Columbia, Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, Pennsylvania, Princeton, Rochester, and Yale.

Contemplated technical installations include a cyclotron of 500,000,000 volts; a synchrotron of comparable size; and a uranium pile capable of producing a great variety of radioactive products useful in physical and biological research. New construction will provide laboratories devoted to biological, chemical, physical, medical, and engineering research in 10 or 12 buildings planned on the tract of 3,700 acres. The community, technical and nontechnical, will comprise about 1,000 persons. The technical personnel will include a permanent staff as well as scientists on leave from various universities. Seminars for the staff and graduate students are planned for the summer sessions. The primary purpose of the project is to facilitate pure research, looking toward the peacetime application of nuclear energy in industrial and medical fields and toward the training of more scientific personnel.

"It should be emphasized," Dr. Morse said, "that the project is in no way limited to scientists of the nine universities named. This project will enable and encourage the scientists of all universities, large or small, not only in the East but from other sections of the country as well, to cooperate in pure research."

Dr. Morse since 1931 has been a member of the staff at Massachusetts Institute of Technology, where he is now full professor. He was co-author with Edward U. Condon, head of the National Bureau of Standards, of an early textbook on *Quantum mechanics,* published in 1929. During the war he served the military forces in several important scientific capacities. In 1940 he headed the National Research Council Committee on Sound Control in Combat Vehicles. In 1942 he organized and became director of the Antisubmarine Warfare Operations Research Group, U. S. Navy.

The shortage of young scientific investigators, arising from the interruption of their studies through engagement in war activities, has raised serious problems in educational and other institutions requiring the services of research workers. In order to meet this situation, at least in part, the Rockefeller Foundation made a grant of $335,000 to the National Research Council in the autumn of 1944 to provide predoctoral fellowships in the natural sciences for the purpose of enabling such persons to complete their studies for the Ph.D. degree as soon as possible.

According to Detlev Bronk, chairman of the National Research Council, a committee consisting of the following persons was appointed to administer the fellowships: John T. Tate, research professor of physics, University of Minnesota (chairman); Henry A. Barton, director, American Institute of Physics; Charles W. Bray, professor of psychology, Princeton University; Detlev W. Bronk, professor of biophysics, University of Pennsylvania; Luther P. Eisenhart, dean and professor emeritus of mathematics, Princeton University; and W. Albert Noyes, Jr., professor of chemistry, University of Rochester. In January 1946 Dr. Noyes succeeded Dr. Tate as chairman.

The Committee began its deliberations in June 1945, and applications were first received during the fall of 1945. In a very short time it developed that the number of applications would far exceed predictions, and the Rockefeller Foundation subsequently made a grant of $250,000 in addition to the amount originally given.

The applications received each month increased progressively as indicated by the number reviewed prior to the various meetings of the Committee: October, 202; November, 314; December, 330; February, 510; and March, 946.

The large number of applications received just before the final date of 1 February 1946 placed an unexpected burden on the Committee and created several problems which could not have been fully anticipated. Owing to the fact that many of the men desired to begin their graduate studies as early as 1 November 1945, the Committee decided to make some awards at its meeting in October. Since men in certain sciences were deferred from the Selective Service to a greater extent than in others, and since in some sciences men engaged in war work were located in a few central laboratories while in other

fields they were widely distributed, there was a tendency for the applications in some sciences to be filed much later than in others.

At each meeting the awards were apportioned generally according to the number of applications reviewed in each science, but at the final meeting the number awarded was such as to make the distribution among the various sciences approximately proportional to the final percentage of applications in each science, so as to assure the development of men in all fields.

The following table shows the number of applications and the number of awards in each science:

Science	*Applications*	*Awards*
Biology	266	20
Chemistry	733	61
Geology	127	9
Mathematics	207	18
Metallurgy	14	3
Physics	841	75
Psychology	114	10
Total	2,302	196

The stipends are $1,200 per year for single men and $1,800 per year for married men. In addition, an amount up to $500 per year is allowed for tuition and fees. For men who receive benefits under the G. I. Bill of Rights the stipends are such as to bring total income to the above figures, *i.e.* $420 additional for single men and $720 additional for married men.

Since all awards of fellowships are made for one year and renewal is contingent upon evidence of satisfactory work, the Committee will have to maintain records of the recipients and receive periodic official reports from the institutions where the men are enrolled.

Finally, it was felt by the Committee that when a recipient receives an additional stipend from other sources, there should be a reduction in the fellowship stipend as in the case of veterans. It was believed that the amount of money available should be used as far as possible for the largest number of persons.

The applications in the various sciences were first reviewed by special panels in which, altogether, over 50 persons took part. The Committee is much indebted to those men for their generous assistance.

The Association for the Study of Internal Secretions has announced the winners of the Squibb and Ciba awards made annually for outstanding investigation in the field of endocrinology. The award furnished by E. R. Squibb and Sons was made to Carl G. Hartman, of the University of Illinois, for his fundamental work on the physiology of reproduction and the hormonal factors in menstruation. The award for younger investigators, made possible through the grant of Ciba Pharmaceutical Products, Inc., went to Martin M. Hoffman, of McGill University, for his work on the metabolism of estrogens and progesterone and his observations on the excretion of cortin in the urine following trauma.

The Edgar Fahs Smith Memorial Collection in the History of Chemistry, University of Pennsylvania, announces the appointment of the following Advisory Committee to the Collection: C. A. Browne, Washington, D. C.; Henry M. Leicester, San Francisco, California; Herbert L. Klickstein, Lt., USNR; and Claude K. Deischer, University of Pennsylvania.

The British Nutrition Society and *The British Council* sponsored a conference of nutrition scientists from Europe and the United States on 4–20 July. After the formal meetings, held at the London School of Hygiene and Tropical Medicine, the delegates visited research laboratories and attended additional conferences in England and Scotland. Representatives from the United States were F. B. Morrison, Cornell University, and C. G. King, Nutrition Foundation and Columbia University. The United Nations were represented by W. R. Aykroyd, Food and Agriculture Organization, and Joseph Needham, UNESCO. There was unanimous agreement that preliminary steps should be taken toward forming an international organization of nutrition scientists within the framework of the United Nations.

A number of postdoctorate research fellowships for the study of factors affecting the production of antibiotics and their action on human, animal, and plant diseases have been announced by the University of Wisconsin. The fellowships, established by Schenley Laboratories, Inc., and Schenley Distillers Corporation, through their affiliate, the Schenley Research Institute, are for a three-year period and will be assigned by the University to the Departments of Agriculture, Bacteriology, Biochemistry, Plant Pathology, Veterinary Science, and Botany, at Madison, Wisconsin. They will come under the immediate supervision of W. C. Frazier, Elizabeth McCoy, M. J. Johnson, H. A. Lardy, W. H. Peterson, E. E. Snell, M. A. Stahmann, F. M. Strong, G. W. Keitt, J. C. Walker, C. A. Brandly, S. H. McNutt, and J. F. Stauffer. The fellows will be appointed by the University on the basis of proved ability in their fields and will receive salaries of $3,600 to $4,000 a year. The total of grants, including allowances for working expenses, will be approximately $110,000. Though the field and scope of the program have been arranged by discussions between the University faculties and E. C. Williams, vice-president and director of research of the Corporation, the fellow-

ships are granted without conditions of any kind and will be administered under the sole discretion of the University.

The 50th anniversary of the establishment of the first psychological clinic at the University of Pennsylvania by Lightner Witmer will be celebrated during the 54th annual meeting of the American Psychological Association at Philadelphia, 3–7 September. Laurance F. Shaffer, Columbia University, Edgar A. Doll, Vineland Training School, and Paul R. Hawley, Chief Medical Director, Veterans Administration, will speak at a program in Houston Auditorium at 8:15 3 September.

Yale University announces an expansion of research in the field of astrophysics supported jointly by the Departments of Astronomy and Physics. Lyman Spitzer, Jr., has been promoted to an associate professor of astrophysics and Rupert Wildt has been appointed assistant professor of astrophysics. Joseph Ashbrook has been appointed to the Department of Astronomy to succeed Victor Goedicke, who has become associate professor of mathematics and astronomy, Ohio University, Athens, Ohio.

The Rumford Committee of the American Academy of Arts and Sciences is able to make grants in support of original researches in the fields of heat and light. Application should be made in the form of a letter describing briefly the research in progress, the amount of the grant desired, the purpose for which it is needed, the support that is being provided by the institution with which the applicant is connected, and other relevant details. Communications from competent endorsers of the research project would be of service to the Rumford Fund Committee, the chairman of which is Harlow Shapley, Harvard College Observatory, Cambridge 38, Massachusetts. Grants in excess of $400 or $500 have rarely been made.

Elections

The Thomas Alva Edison Foundation was incorporated on 1 July "for the advancement of education and scientific research." At a meeting of the trustees on 15 July Charles F. Kettering was chosen president. The following were named vice-presidents: Thomas J. Watson, president of the International Business Machines Corporation; Karl T. Compton, president of Massachusetts Institute of Technology; Robert C. Clothier, president of Rutgers University; Gano Dunn, president of the J. G. White Engineering Corporation; and Frank F. Tait, chairman of the Dayton Power and Light Company.

W. Winans Freeman, president of the Edison Pioneers, was elected treasurer, and John Edison Sloane, grandson of the inventor, secretary. Mrs. Edison was elected honorary chairman; Mrs. John Eyre Sloane, the inventor's daughter, honorary vice-chairman; and former Gov. Charles Edison, a son of the inventor, honorary president.

The Oregon Chapter of Sigma Xi, University of Oregon, elected the following officers for the coming academic year at its May meeting: Arnold L. Soderwall, Department of Biology, president; Lloyd W. Staples, Department of Geology, secretary; and Kenneth S. Ghent, Department of Mathematics, treasurer.

The Chicago Section of the American Chemical Society has elected the following officers for 1946–47: Robert K. Summerbell, Northwestern University, chairman, succeeding M. H. Arveson; Charles L. Thomas, Great Lakes Carbon Company, first vice-chairman; Albert L. Sidwell, Jr., American Medical Association Laboratory, second vice-chairman; George S. Schmeing, Loyola University, secretary; and Walter M. Urbain, Swift & Company, treasurer.

Under the direction of the new chairman the Section will sponsor the 110th national meeting of the American Chemical Society and the fourth National Chemical Exposition, both of which will be held in Chicago the week of 9 September.

Recent Deaths

John Taylor Hopkins IV, 18, of Washington, D. C., a 1946 winner in the 5th Annual Science Talent Search, died on 17 August in Jacksonville, Florida, when lightning struck his steel fishing rod and all efforts to revive him failed, according to an announcement from Science Service.

Federigo Enriques, algebraic geometer, emeritus professor of mathematics, University of Rome, died on 14 June 1946.

Morris S. Fine, 60, who was staff director of research for the General Foods central laboratory in Hoboken, died on 15 August at Presbyterian Hospital, New York, after an illness of 10 days.

Julian P. Maes, 35, assistant professor of pharmacology at the Dartmouth Medical School, died on 7 August at Malines, Belgium, of a cerebral hemorrhage. Dr. Maes and his family had sailed on the S. S. Argentina, 19 July, to visit his parents and to collect research data left at the University of Brussels in 1941.

Letters to the Editor

Terrestrial Thermodynamics of an Ice Age

In the article by the late Gilbert N. Lewis, entitled "Thermodynamics of an Ice Age: the cause and sequence of glaciation" (*Science,* 1946, **104**, 43–47), no mention is made of the theory proposed by Dr. Edward O. Hulburt, namely, that the warming and cooling of the earth is controlled by the proportion of carbon dioxide in the earth's atmosphere. This theory is important in relation to the growth of vegetation, which removes the carbon dioxide from the air and consequently can explain the alternate cooling and warming of the earth, and the Carboniferous ages and their sequelae.

KNIGHT DUNLAP

University of California, Los Angeles

Effect of Streptomycin on Budwood Infected With *Phytomonas pruni*

Streptomycin, both crude and crystalline, has been used successfully in freeing plum budwood from infection with *Phytomonas pruni.* The crude streptomycin was produced in this laboratory by a culture of *Streptomyces griseus* supplied by Selman A. Waksman, New Jersey Agricultural Experiment Station; the crystalline streptomycin was supplied by Schenley Laboratories, Inc.; and the budwood came from hybrid plum trees sent to us by a large nursery company. The nursery supplying the infected trees stated: "Until we can obtain disease-free trees it seems that the propagation of this otherwise valuable variety will be impractical." Unless the budwood could be disinfected without injury, the bacterial disease (black spot and canker) would be transmitted to the new tree.

Budwood used in the experiments consisted of infected pieces of branches 5.5 to 6.5 inches long, on which bacterial lesions ranged in length up to 1 inch; in width, up to those almost girdling the branch, and in depth, up to those reaching inward to the stele. Some lesions had cracked open.

The pieces of budwood were placed in a vertical position in beakers, with the basal 1½ inches immersed in the streptomycin solution; other pieces were placed in a horizontal position and completely submerged in the solution. The budwood thus arranged was then placed in an enclosed chamber and submitted to negative pressure by connecting the chamber to an ordinary laboratory-tap aspirator. The pieces of budwood were carefully cultured before and after the treatment. The experiments were run at room temperature, 22°–25° C. Controls were likewise handled with sterile distilled water taking the place of the streptomycin. After treatment the pieces of budwood were also tested for injury to the buds by giving them a chance to sprout and develop.

Time has not permitted definite determination of the minimum length of treatment or the minimum concentration of streptomycin necessary for complete disinfection. However, crude streptomycin showing a strength of 6–8 Oxford units (as tested against *Staphylococcus aureus*) and a strong concentration of the crystalline drug in sterile distilled water, acting overnight as described, resulted in budwood from which no organisms whatever could be cultured. The treated budwood produced clean leaves, and no visible evidence of injury was apparent. Controls in culture gave abundant growth of *P. pruni* that was carefully checked against a standard culture of the plum-strain of the bacterium from the American Type Culture Collection.

J. G. BROWN and DON M. HER

University of Arizona and Arizona Agricultural Experiment Station, Tucson

Isolation of Type A Influenza Virus in Recent Epidemic in Chicago Area

Type B influenza virus has been reported (*Epidemiol. Inf. Bull.* (*UNRRA*), 1946, **2**, 105) as the cause of the mild epidemic which reached its peak in December 1945 in this country and a month or two later in England. So far we have seen no reports of the isolation of Type A virus during the past winter in the United States.

Only 30 specimens were examined in our laboratory and from only one of these was virus obtained. Since it was identified as a Type A virus, however, we feel that its isolation is worth reporting. Failure to obtain virus from a larger proportion of cases may have been due to the conditions under which specimens were delivered to the laboratory.

Preliminary experiments in our laboratory had indicated that influenzal virus in throat washings might be expected to survive transmission through the mails if not delayed too long in transit. It did not prove possible, however, to carry out arrangements with three local hospitals whereby duplicate specimens of throat washings were to be sent to our laboratory, one by messenger and the other by mail. Most of them were transmitted by mail only and were sent during the period of congested mail service around Christmas and New Year's Day. From one specimen which had been stored in a dry-ice refrigerator until it could be delivered by messenger virus was isolated as mentioned above.

Four serial passages through 10-day eggs were made of each specimen, three eggs at each passage. For the first passage a portion of the specimen was treated for 15 minutes with enough penicillin to provide 100 Oxford units/0.1 cc., the amount inoculated into each egg. Previous tests in our laboratory had shown that several times this amount would not retard multiplication of PR8 virus in eggs.

Serial mouse passages, usually four in number (two to four mice each passage), were carried out on the first 17 specimens received. Single hamsters were injected intranasally with each of the 13 remaining specimens. For

the animal inoculations treatment of the specimens with penicillin was omitted. All animals after inoculation were kept in a separate room so that chance exposure to infected stock could be excluded.

The successful isolation was made in mice. Slight pulmonary lesions occurred in one mouse of the third passage and in the fourth passage a scant 2-plus hepatization was produced. These lungs were inoculated into 10-day eggs and on first egg passage the pooled allantoic fluid possessed a CCA titer of 1/640.

This allantoic virus was identified as Type A by means of the agglutinin-inhibition test, using sera produced in rabbits against the PR8 strain of Type A and the Lee strain of Type B influenza virus.

GEORGE F. FORSTER and HOWARD J. SHAUGHNESSY
Illinois Department of Public Health, Division of Laboratories, Chicago

Initiation of Geological Investigations in the Panama Canal Zone

A letter received by me from Viscount Bryce more than 25 years ago seems to possess more than passing interest. A copy follows:

"Aug. 31, 1920
Hindleap, Forest Row 6, Sussex

"I thank you cordially for sending me the Smithsonian Institution volume relating to the geology & paleontology of the Panama Canal, which I shall read with the greatest interest, though the little geological knowledge I learnt long ago from my father has, in the process of years, left little more than an unabated interest in the subject.

"I may mention that when I visited the Canal in 1910 I found that no proper geological examination of the Isthmus was being made, & wrote at once to President Taft, pointing out the importance of improving the opportunities which the excavation of the Canal afforded. He promptly thereupon had a competent geologist sent there to take the matter up. I have forgotten the name, but it was probably Dr. D. F. Macdonald mentioned in your preface.

"I often think of the pleasant times I had in Washington with the scientific groups at the Cosmos Club & wish the Atlantic were not so wide.

"With our kind regards to Mrs. Vaughan & yourself
Very truly yours
[signed] James Bryce"

The volume to which the letter refers is entitled *Contributions to the geology and paleontology of the Canal Zone, Panama, and geologically related areas in Central America and the West Indies* (*U. S. nat. Mus. Bull. 103*, 1919–20. Pp. xviii + 613. Illustrated). American geologists were aware of the excellent opportunity afforded for a study of the geology of the Isthmus of Panama, but were uncertain as to how to establish contact with the Isthmian Canal commissioners. The effect of the letter from Lord Bryce to President Taft was to establish contact between the commissioners and the U. S. Geological Survey. The "competent geologist" mentioned by Lord Bryce was C. Willard Hayes. After the latter's return to Washington Donald F. MacDonald was recommended and appointed Commission Geologist in 1911. In October and November 1911, I spent a full month in the Canal Zone working with Mr. MacDonald, and after my return to Washington organized, as a cooperative enterprise between the Canal Commission, the Smithsonian Institution, and the U. S. Geological Survey, the studies the results of which appeared in the volume above mentioned.

In this connection another investigation of phenomena exhibited by the Canal should be mentioned. Early in 1915, because of the serious landslides along the sides of and in the Canal, the engineers in charge of the project wished help in understanding the causes of the slides. In response to the desire of the engineers President Wilson referred the matter to the president of the National Academy of Sciences, William H. Welch, who appointed a committee of 13 under the chairmanship of C. R. Van Hise to study and report on the problem. The full report, entitled "Report of the Committee of the National Academy of Sciences on Panama Canal slides," was published in 1924 (*Mem. nat. Acad. Sci.*, Vol. 18). This report is a valuable addition to the literature of engineering geology.

Lord Bryce had many friends in this country, which he understood so well and to whose welfare he was so devoted. The role he played in initiating geological investigations in the Panama Canal Zone has not been generally known. It extends the basis of the high esteem in which our fellow citizens hold him.

T. WAYLAND VAUGHAN
U. S. National Museum, Washington, D. C.

On the Term "Normality Factor"

The term "Normality Factor" is occasioned in a few biochemical texts (laboratory manuals). According to one author, "A normality factor is a number which expresses the strength of a solution in terms of its normality. Thus if a solution is 0.2N, it is 0.2 as strong as a normal solution."

In effect, this statement says that there is no difference between the original term, normality, and normality factor (NF). Then why introduce it? The universal terminology and concept of normality is accepted and used in practically every analytical text published.

It is difficult to see either the logic or convenience in the interpolation of such a term. An example of the calculation of NF is as follows: 25 cc. base : 50 cc. acid : x NF acid : 0.010 N (NF) base

$$x = \frac{25 \times 0.010}{50} = 0.005 \text{ NF acid}$$

In the usual interpretation this is simply the normality of the acid.

In using the NF the following typical formula is employed:

$$\frac{\text{cc. acid} \times \text{NF acid} \times \text{mg. eq. of } x \text{ substance} \times 100}{\text{wt. of sample}} = \text{per cent } x \text{ substance}$$

The use of NF here is similar to using normality—which it would have to be, since it is *the same value.*

The point of this discussion is to bring out the inadvisability of introducing terms into the literature which tend to add confusion where simplicity is not, unfortunately, one of its virtues. If the concept is one of simplifying nature, it should be incorporated into biochemical texts. Can the added advantage (?) of NF over N in quantitative analysis be included in this category?

JAMES H. M. HENDERSON

Tuskegee Institute, Alabama

Rockets vs. Meteoroids

Rockets used for exploration of the atmosphere and possibly of interplanetary space must run the risks of destruction through collision with meteor-forming particles. As it is now possible to send rockets into the upper atmosphere, where collisions may occur, it is of some importance to survey the chances of such collisions.

A meteor, or more popularly a "shooting star," occurs when a small solid particle, or meteoroid, weighing a few milligrams dashes into the atmosphere with a velocity between 20 and 70 km./sec. When at these velocities an atmospheric atom or molecule collides with the meteoroid, a few atoms of the particle are chipped off and fly out with considerable kinetic energy which, through successive collisions with other atoms, is transformed into radiation. When collisions between the particle and atmospheric atoms become sufficiently frequent, the cylindrical cloud of hot gas formed around the path of the particle is observed as the "meteor." The great majority of meteors are first visible at heights between 100 and 115 km. How deeply they penetrate the atmosphere before being consumed varies with the mass of the particle; few, however, remain visible below 65 km.

At heights below 65 km. the chances of collision between a meteoroid and a rocket are very small, for few meteoroids are present. Above 85 km., however, a rocket is exposed to possible collision with the steady hail of particles. If a particle is checked abruptly, it will vaporize, explode, blow a hole in the rocket, and very likely destroy it.

The earth's daily catch of particles producing meteors bright enough to be seen by the unaided eye is usually estimated as around 24,000,000. Counts of telescopic meteors too faint to be observed with the unaided eye indicate that the total number of meteoroids impinging daily upon the atmosphere is much greater. The results of the Arizona Meteor Expedition (*Harvard Observ. Ann.*, 1937, **105**, No. 32) and my own observations (*Proc. Amer. phil. Soc.*, 1939, **81**, 493) indicate that down to the ninth magnitude the daily total is about a billion: 10^9. Even this figure, which does not include very faint meteors, is certainly too small, but it can be used for some enlightening calculations.

The total area of the earth's atmosphere is about 5×10^8 sq. km. If 10^9 meteors enter it each day, the frequency per square kilometer is about two particles daily. Let us assume that the cross section of a typical rocket is 5 sq. m. Then, on the average, one meteor will pass through a "rocket-sized area" once in 10^5 days; or such a patch of atmosphere will be pierced by a meteor sometime during one day in each 300 years.

It is probable that the total number of meteoroids entering the atmosphere daily is at least a thousand times greater than 10^9. Even so, at a daily rate of 10^{12} particles, a rocket-sized area will be pierced by a meteoroid only once each 100 days. Inasmuch as a rocket used for high-altitude soundings will be exposed to collision at the top of the atmosphere for only a short time, there is very little chance that such a rocket will be struck.

Rockets fired toward the moon will be traveling for some time. Let us assume that the fuel capacity of a rocket limits its extra-atmospheric velocity to 1 km./sec. As the average distance to the moon is 384,000 km., a rocket traveling the shortest path would require nearly four and one-half days for the trip. It seems, therefore, that some appreciable fraction of rockets shot toward the moon (4 per cent for the conditions assumed here) would be destroyed.

Interplanetary travel constitutes the most hazardous journey for the rocket enthusiast. Of all the planets Venus comes the closest to the earth, reaching a minimum distance of 42,000,000 km. If an interplanetary rocket traveled a mere kilometer per second in space, it would require nearly 500 days to reach Venus. While existing information on the space density of meteoroids is uncertain within rather wide limits, it seems probable that a sizable proportion of space ships would not survive exposures of several hundred days to the hazards of collision with meteoroids. By the time space ships are built and the other details of interplanetary travel are settled we may have means of fending off or of dodging the oncoming particles. Certainly by then more precise information should be available on the total number of particles striking the atmosphere daily.

FLETCHER WATSON

Harvard University

Rediscovery in the Vitamin C Field

Apropos of the series of articles dealing with rediscovery in the vitamin A field (*Science*, 1946, 103, 173, 281, 404), it is with bowed head that we report the existence of a similar situation in the vitamin C field. At the February 1945 meeting of the Société Belge de Biologie, in Brussels, G. Barac and one of the undersigned (Roseman) reported what we believed to be a new color reaction between vitamin C and titanium salt, similar to that obtained (and well known) with hydrogen peroxide and titanium salt. Work dealing with this and related observations (*C. R. Soc. Biol. Paris*, in press) was done in the laboratory of L. Brull at the Bavière Hospital of the University of Liége, during the period December 1944 to February 1945. Liége was being rocked and destroyed by flying bombs, and there were the menacing days of the enemy's Ardennes break-through. We regret that, despite our general knowledge of the chemical literature on titanium and vitamin C and our actual search of the literature available to us at the time, we

nevertheless missed an article by J. Ettori, published just 10 years ago (*C. R. Soc. Biol. Paris*, 1936, 202, 852), wherein is described a reaction similar to the one reported by us at Brussels.

Might we add a word of high praise for such men as Prof. Brull, Prof. Gillet, Dr. Lambrechts, Dr. Barac, and their Belgian colleagues at the University of Liége who, in the face of many dangers and personal disasters, bravely continued their scientific researches throughout the war, and who, with their families, extended every kindness and courtesy to the American soldier and scientist.

R. Roseman and B. W. Allan

The Glidden Company, Baltimore, Maryland

The Occurrence of Crystalline Naringin on Grapefruit Rind

Naringin ($C_{27}H_{32}O_{14} \cdot 2H_2O$), the glucoside which imparts the characteristic bitterness to grapefruit, was first discovered by DeVry in 1857 (*Jb. Pharmacog*, 1857, 132, 1866). According to Poore (*Ind. eng. Chem.*, 1934, 26, 637), when grapefruit is stored, the content of naringin appears to diminish in both the peel and the juice.

Not long ago the writer's attention was called to aggregates of crystalline material that had collected on the surface of grapefruit rind, a cursory examination of this crystalline material indicating that it closely resembled naringin. The sample of grapefruit examined had been in the laboratory for some time and was gradually decomposing. Due to the pressure of other duties at the time, no more attention was paid to the exhibit, although a record of preliminary observations was made. More recently, opportunity was afforded for repeating the test for the purpose of definitely confirming the results heretofore casually observed. For this purpose a one-half portion of a grapefruit was placed, cut side down, under a bell jar, the latter not resting tightly over the fruit but on glass supports to permit ingress of air. The cut portion soon became inoculated with *Aspergillus niger* (Cramer) Van Tieghem. (The writer is indebted to John F. Reed, Baldwin-Wallace College, Berea, Ohio, for this identification.) In the course of 10 days, the growth of the *Aspergillus* was quite considerable, the fruit was rapidly decomposing, and there was formed on the surface of the rind numerous yellowish-white aggregates of material. These could be readily removed with a needle to an object slide and allowed to dry at room temperature.

The dried, yellowish-white masses, upon microscopic examination with crossed nicols, consisted of narrow rods and needles showing parallel extinction and negative elongation. The significant refractive indices as determined by the immersion method were: $\alpha = 1.480$ (shown lengthwise), $\beta = 1.625$ (shown crosswise), $\gamma = 1.668$ (shown crosswise)—all ± 0.002. These optical crystallographic data all agreed with those characteristic of naringin obtained from grapefruit and Florida and California oranges.

The fact that naringin crystallizes out on the rind of the grapefruit as it decomposes is of interest. The objective evidence indicates that conditions were suitable for the occurrence of these aggregates, although it has not been demonstrated that the increasing growth of the *Aspergillus* was necessarily wholly responsible for it. Both the changes initiated by the progressive development of mold growth and the general chemical decomposition of the fruit might have some effect on the appearance of the glucoside on the rind in crystalline form.

George L. Keenan

P. O. Box 113, Strongsville, Ohio

Book Reviews

Rockets. Robert H. Goddard. New York: American Rocket Society, 1946. Pp. xix + 69; 10. (Illustrated.) $3.50.

Dr. Goddard is well known as a pioneer, if not the pioneer, of modern rocketry. Unfortunately, this book is not, as the title might indicate, a general discussion of the principles or accomplishments of rocketry but simply a reprinting of two Smithsonian Institution publications of the author—apparently his only publications in the field.

While an historical service is unquestionably performed in making available these out-of-print publications of the "father of modern rocketry," the dates of their original publication (1919 and 1936, respectively) and the tremendous development of rocketry in the last few years make it unreasonable to expect any great scientific value to accrue to the present-day reader.

The earlier and by far the longer paper is entitled "A Method of Reaching Extreme Altitudes" and gives a discussion of the possibility of using (sounding) rockets for the exploration of the upper atmosphere. It includes a presentation of Dr. Goddard's early experimental determinations of the gas velocity of smokeless powder rockets and a computation of the weights required to reach various extreme altitudes (125,000 feet and up).

The entire paper exhibits a rather odd blend of farsightedness and a surprising scientific naïveté. The soundness of the basic conception, that a rocket provides a practical means of attaining extreme altitudes, has been amply demonstrated by now. In addition, the extreme importance of a high gas velocity and a high ratio of fuel to empty weight is properly emphasized. Other suggestions presented in this 1919 paper which have subsequently proved of value include the idea of a multistage

rocket and the limiting case of a rocket with casing which is continuously discarded as the fuel burns. No practical means for achieving this last is suggested. On the other hand, there is no apparent recognition of the various factors influencing the gas velocity in a rocket. Dr. Goddard describes experiments in which a gas velocity approaching 8,000 feet per second was obtained in rockets using smokeless powder of the so-called "infallible" type. This gas velocity was obtained through the use of extremely high pressure. (The pressure is not recorded, but it is stated that the rocket, which had an inside diameter of about 1 inch and a wall 0.46 inch thick, was bulged.) In the subsequent calculation of rocket performance it is assumed that a gas velocity of 7,500 feet per second is obtainable without any recognition of the fact that this might require high-pressure operation. More seriously, the influence of molecular weight on gas velocity is apparently not recognized even in the 1936 paper. For example, it is implied that if a combination of hydrogen and oxygen is used as propellant, an optimum gas velocity would occur at a stoichiometric mixture, whereas it is now well known that optimum gas velocity is obtained with a considerable hydrogen excess.

One historical curiosity that occurs in the 1919 paper is a theory of the nature of the upper atmosphere, credited to A. Wegener:

> Wegener . . . concludes that there are four rather distinct regions or spheres of the atmosphere in which certain gases predominate: the troposphere, in which are the clouds; the stratosphere, predominantly nitrogen; the hydrogen sphere; and the geocoronium sphere. This highest sphere appears to consist essentially of an element, "geocoronium," a gas undiscovered at the surface of the earth, having a spectrum which is the single aurora line, 557 μμ, and being 0.4 as heavy as hydrogen. The existence of such a gas is in agreement with Nicholson's theory of the atom. . . .

The calculation of the weight of rocket required to reach extreme altitudes must be considered as optimistic even in the light of present knowledge and techniques. These calculations are based on the gas velocity of 7,500 feet per second, which clearly is obtainable, though better than V-2 performance, but also on a ratio of full-to-empty weight of 15, which has not been approached so far. Finally, it is assumed that casing is discarded as the fuel burns, a desideratum which has not been even approximately attained.

The second paper in the book, entitled "Liquid-propellant Rocket Development," describes very briefly progress made up to 1936 in the development of a vertical-firing liquid fuel rocket. Operating motors using liquid oxygen and various liquid hydrocarbons, both pressurized and pumped, were constructed and fired in flight. A gyroscopic stabilization device to control the rockets to a near-vertical path was developed. Unfortunately, no details of these various devices are given in the paper, although some interesting photographs of the tests are included.

RICHARD B. KERSHNER

Applied Physics Laboratory
The Johns Hopkins University

Handbook of South American Indians. **Vol. I: *The marginal tribes;* Vol. II: *The Andean civilizations.*** **Julian H. Steward. (Ed.) (Smithsonian Institution Bureau of American Ethnology Bull. 143.) Washington, D. C.: Government Printing Office, 1946. Pp. xvii + 624; xxxiii + 1035. (Illustrated.) $2.75; $4.25.**

The books under review are the first two of the five volumes of the long-awaited *Handbook of South American Indians,* sponsored by the Smithsonian Institution and the National Research Council and prepared in cooperation with the U. S. Department of State as a project of the Interdepartmental Committee on Cultural and Scientific Cooperation. In his foreword Dr. Wetmore rightly says: "The present monumental work is ideally suited to carrying out the purpose of the Smithsonian Institution 'the increase and diffusion of knowledge'. . . ." Certainly no more impressive factual digest of anthropological knowledge covering so large a region has ever appeared. These volumes are also noteworthy as the product of scientific collaboration. Authorship of the various chapters is almost equally distributed between citizens of the United States of North America and citizens of various Latin-American republics. The editor and the committee of the National Research Council are to be congratulated upon securing the cooperation of such a varied and distinguished group of scholars.

The two volumes are organized according to the plan followed by A. L. Kroeber in his *Handbook of the Indians of California* rather than that used by F. W. Hodge in editing the earlier *Handbook of* [*North*] *American Indians*; that is, the data are integrated according to certain major topics rather than divided among smaller headings (place and tribal names, ceremonies, individuals and the like). Both volumes are magnificently illustrated and have bibliographies that in themselves are notable contributions to knowledge. The amount of work that must have gone into planning, seeking, and selecting the drawings and photographs is stupendous, but the results more than justify the effort. Particularly praiseworthy is the reproduction (or redrawing) of illustrations from rare or inaccessible travel books of past centuries. A nice balance is achieved between pictures of landscape, people, and artifacts. The maps are likewise splendid. Contributors follow a standard outline (with some deviations) in treating each people. This outline is set forth as follows by Dr. Steward:

> The articles start with an Introduction, which often includes a geographical sketch. Tribal Divisions and History then follow. The history traces the major post-Contact events which have affected the tribe. When local archeology can definitely be linked with the historic tribe, it is included as a background to the history. Otherwise it is treated in a separate article. The next section evaluates the principal anthropological sources. The cultural summaries commence with Subsistence Activities (Farming, Collecting Wild Foods, Hunting, Fishing, and Food Preparation and Storage). Then come Villages and Houses, Dress and Ornaments, and Transportation. Manufactures, which follows, is essentially technological; the functional aspects of material culture are described under other headings appropriate to the use of the objects. This section includes Basketry, Weaving, Ceramics, Bark Cloth, Metallurgy, Weapons, and other types of manufactures. The following section is usually Trade or Economic Organization. Social and Political Organization, which follows, describes the general patterns and structure of the groups. If necessary, special accounts of Warfare and Cannibalism come next. Life Cycle then sketches Birth, Childhood, Puberty rites and initiations, Marriages, and

death observances. Esthetic and Recreational Activities includes Games, Music, Musical Instruments, Dancing, Narratics, and Intoxicants. Religion describes beliefs about supernatural powers and beings, and magical and religious practices, functionaries, and structures. It also includes concepts and practices concerning the medicine man or shaman, unless shamanism is sufficiently developed to warrant a separate section. Mythology and Folklore follow. Finally comes Lore and Learning, which includes cosmogony, measurements of weight, time, and space, and other special beliefs or concepts of an essentially nonreligious nature.

Volume I begins with an introduction by the editor, outlining the scope of the work and sketching its background. Part 1 is devoted to the Indians of southern South America, introduced by a general sketch on "The Southern Hunters" by John M. Cooper. There follow two excellent sections on "The Archeology of Patagonia" by Junius Bird and "The Archeology of the Greater Pampa" by Gordon R. Willey. The ethnography of various tribes and groups is then presented by Cooper, Bird, Frau, Lothrop, and Serrano. Parts 2 and 3 are similarly given over to the Indians of the Gran Chaco and eastern Brazil, respectively. The general level is high enough to make any singling out of particular authors somewhat invidious. The reviewer, however, was especially struck by the deep learning and sound judgment revealed in Father Cooper's several contributions and by that unrivaled sense of firsthand intuitive familiarity with the phenomena conveyed by Dr. Métraux's articles (including, of course, those that he authored jointly with that distinguished South American ethnologist, the late Curt Nimuendajú).

In Volume II Wendell Bennett leads off with an admirably succinct and simple introduction to the Andean Highlands in general. This broad panorama, which surveys the general setting, cultural origins, population, and the environment and cultural trends of the central, southern, and northern regions, helps enormously toward orienting the nonspecialist reader on the more detailed treatments that follow and gives a measure of integration and coherence to the whole book. The remaining three parts of this volume are regionally organized (the Central Andes, the Southern Andes, the Northern Andes). Notable throughout are the skillful blending of archeological, historical, and ethnographical knowledge and the attention given to post-Conquest cultures. Dr. Kubler's chapter on Inca or Quechua culture under Spanish influence is a high-water mark in this respect. Larco Hoyle's reconstruction of the culture patterns of the North Coast of Peru in pre-Spanish times is an outstanding example of how the thoughtful and sympathetic archeologist, really steeped in rich materials, can do ethnology. The first-rate chapters on "The Contemporary Quechua" and "The Aymara" by Mishkin and Tschopik show how much we stand to learn from investigation of living cultures by modern anthropological methods, as opposed to work (however learned and scrupulous) upon literary sources.

The editing is, on the whole, superb. All the editors[1] merit the highest praise. In a work where the complications invite inconsistency and error, very few faults at the mechanical level were noticed. The bibliographies seem extraordinarily complete, although a paper by Henry on the personality of the Kaingang (*Character & Pers.*, 1936, 5, 113–123) and one by Schachtel, Henry, and Henry on "Rorschach analysis of Pilaga Indian children" (*Amer. J. Orthospychiat.*, 1942, 12, 679–712) are not cited. Since this was a venture in hemispheric coperation, the reviewer ventures to ask if it would not have been better to leave the articles by South Americans in the original languages. These volumes, after all, appeal to the scholar rather than to the general reader, and any scholar in the South American field ought surely to be able to read Spanish and Portuguese. As they stand, South American scientists are expected to read everything in English.

Readers who may be disappointed by a relative neglect of physical anthropology and of those aspects of linguistics that do not bear directly upon problems of history and of classification will be glad to learn that these matters are to be covered more fully in Volume V of the *Handbook*. Archeology, history, and ethnography are given as much space as one could possibly expect in a handbook series. However, a disproportionate emphasis is given to "material culture" and subsistence activities in general. Even in the treatment of other aspects of culture the selection is somewhat conventional. Because Tylor and other great 19th-century anthropologists became interested in the disposal of the navel cord, this detail is carefully documented, but other facts (e.g. characteristic motor habits of mothers in handling infants) which recent research has shown to be of at least equal importance are almost ignored. It must be admitted, however, that this is due in part to deficiencies in the literature. But the *tendency* in these volumes is still to "give ten pages to the description of how pots are made and two lines to nursing practices." Indeed, only Tschopik and Mishkin even approximate an adequate handling of the data needed by students in the field of culture and personality.

For those who are willing to take "the facts" and let the concepts go, these books deserve criticism only as to relatively minor details. Those who think that *explicit* theory is an indispensable part of any major integrative publication will have certain reservations, however highly they value the intensive investigation and intelligent synthesis that the *Handbook* exemplifies. Nor will they be satisfied with the rejoinder that "this is description and descriptive studies of high standard must precede 'theorizing.'" For any system of descriptive categories involves much *implicit* theory. (Note the selectivity involved in the emphasis on subsistence, navel cord as opposed to masturbation taboos, and the like.) Because the theory remains unstated, it is bad theory, since it is not accessible to the same open examination invited by the weighing of the "factual" evidence. Anthropologists will still swallow a theoretical camel while straining at an evidential gnat.

In any event, the succeeding volumes of the *Handbook* will be eagerly awaited.

CLYDE KLUCKHOHN

Harvard University

[1] The editor warmly acknowledges the help given by Drs. Métraux and Bennett in planning and editing these first two volumes.

Scientific Book Register

ANDREWS, GEORGE CLINTON. *Diseases of the skin.* (3rd ed.) Philadelphia-London: W. B. Saunders, 1946. Pp. vi + 937. (Illustrated.) $10.00.

BICKNELL, FRANKLIN, and PRESCOTT, FREDERICK. The *vitamins in medicine.* (2nd ed., rev.) New York: Grune and Stratton, 1946. Pp. xii + 916. (Illustrated.)

BROWN, HARRISON. *Must destruction be our destiny?* New York: Simon and Schuster, 1946. Pp. xiii + 158. $2.50.

CARPENTER, STANLEY J., MIDDLEKAUFF, WOODROW W., and CHAMBERLAIN, ROY W. *The mosquitoes of the southern United States east of Oklahoma and Texas.* (American Midland Naturalist Monogr. No. 3.) Notre Dame: Univ. Press, 1946. Pp. 292. (Illustrated.)

DAVIS, DAVID M. *Urological nursing.* (4th ed.) Philadelphia-London: W. B. Saunders, 1946. Pp. vi + 212. (Illustrated.) $2.25.

DEHAUT, GEORGES. *Les doctrines de Georges Cuvier.* Paris: Paul Lechevalier, 1945. Pp. 33. 130 fr.

ELWYN, HERMAN. *Diseases of the retina.* Philadelphia-Toronto: Blakiston, 1946. Pp. xi + 587. (Illustrated.) $10.00.

EPSTEIN, SAMUEL, and WILLIAMS, BERYL. *Miracles from microbes: the road to streptomycin.* New Brunswick, N. J.: Rutgers Univ. Press, 1946. Pp. xi + 155. $2.00.

FULFORD, MARGARET. *The genus Bazzania in Central and South America.* (Annales Cryptogamici et Phytopathologici, Vol. III.) Waltham, Mass.: Chronica Botanica, 1946. Pp. xv + 175. (Illustrated.) $5.00.

GAMOW, GEORGE. *Atomic energy in cosmic and human life: fifty years of radioactivity.* Cambridge, Engl.: At the Univ. Press; New York: Macmillan, 1946. Pp. x + 161. (Illustrated.) $3.00.

GRAYBIEL, ASHTON, WHITE, PAUL D., WHEELER, LOUISE, and WILLIAMS, CONGER. *Electrocardiography in practice.* (2nd ed.) Philadelphia-London: W. B. Saunders, 1946. Pp. ix + 458. (Illustrated.) $7.00.

GREEN, DAVID E. (Ed.) *Currents in biochemical research.* New York: Interscience Publishers, 1946. Pp. viii + 486. (Illustrated.) $5.00.

GROVER, FREDERICK W. *Inductance calculations: working formulas and tables.* New York: D. Van Nostrand, 1946. Pp. xii + 286. (Illustrated.) $5.75.

HALL, E. RAYMOND. *Mammals of Nevada.* Berkeley-Los Angeles: Univ. California Press, 1946. Pp. xi + 710. $7.50.

HAUPT, ARTHUR W. *An introduction to botany.* New York: McGraw-Hill, 1946. Pp. xii + 425. (Illustrated.) $3.50.

HILTNER, W. A., and WILLIAMS, R. C. *Photometric atlas of stellar spectra.* Ann Arbor, Mich.: Univ. Michigan Press, 1946. Books I–IX. (Illustrated.) $7.50.

JOHNSON, WENDELL. *People in quandaries.* New York-London: Harper, 1946. Pp. xiv + 532. $3.00.

MARSHALL, CLYDE, and LAZIER, EDGAR L. *An introduction to human anatomy.* (3rd ed.) Philadelphia-London: W. B. Saunders, 1946. Pp. xi + 418. (Illustrated.) $2.50.

MORRIS, EVANGELINE HALL. *Public health nursing in syphilis and gonorrhea.* Philadelphia-London: W. B. Saunders, 1946. Pp. iv + 239. (Illustrated). $2.25.

MORSE, MARY ELIZABETH, FROBISHER, MARTIN, and RABIN, COLEMAN B. *Microbiology and pathology for nurses.* (2nd ed.) Philadelphia-London: W. B. Saunders, 1946. Pp. xii + 758. (Illustrated.) $3.50.

MURALT, ALEXANDER V. *Die Signalübermittlung im Nerven.* Basel: Verlag Birkhäuser, 1946. Pp. 354. (Illustrated.) S. Fr. 38.50.

PHILLIPS, H. B. *Analytic geometry and calculus.* (2nd ed.) New York: John Wiley; London: Chapman and Hall, 1946. Pp. xiii + 504. (Illustrated.) $4.50.

RIDER, JOHN F., and ROWE, G. C. BAXTER. *Radar: what it is.* New York: John F. Rider, 1946. Pp. 80. (Illustrated.) $1.00.

SAINT-HILAIRE, AUGUSTE DE. *Esquisse de mes voyages au Brésil et Paraguay.* (Chronica Botanica, Vol. 10, No. 1.) Waltham, Mass.: Chronica Botanica; New York: G. E. Stechert, 1946. $2.00.

SCHLOSSER, RUDOLPH O. *Complete denture prosthesis.* (2nd ed.) Philadelphia-London: W. B. Saunders, 1946. Pp. xv + 466. (Illustrated.) $5.50.

SHAPLEY, HARLOW, RAPPORT, SAMUEL, and WRIGHT, HELEN. (Eds.) *A treasury of science.* New York-London: Harper, 1946. Pp. xii + 772. $3.95.

STANDLEY, PAUL C., and STEYERMARK, JULIAN A. *Flora of Guatemala.* (Fieldiana: Botany. Vol. 24, Pt. IV.) Chicago: Chicago Natural History Museum, 1946. Pp. v + 493. $3.50.

STERN, BERNHARD J. *Medical services by government: local, state, and federal.* New York: Commonwealth Fund, 1946. Pp. xiv + 208. $1.50.

SYMONDS, PERCIVAL M. *The dynamics of human adjustment.* New York-London: D. Appleton-Century, 1946. Pp. xiv + 666. $5.00.

WEIDENREICH, FRANZ. *Apes, giants and man.* Chicago: Univ. Chicago Press, 1946. Pp. vii + 122. (Illustrated.) $2.50.

WIENER, MEYER. (Ed.) *Ophthalmology in the war years.* (Vol. I.) Chicago: Year Book Publishers, 1946. Pp. x + 1166. $13.50.

WILDE, S. A. *Forest soils and forest growth.* (Vol. XVIII.) Waltham, Mass.: Chronica Botanica; New York: G. E. Stechert, 1946. Pp. xx + 241. (Illustrated.) $5.00.

WILSON, D. WRIGHT, NIER, A. O. C., and REIMAN, STANLEY P. *Preparation and measurement of isotopic tracers.* (A symposium prepared for the Isotope Research Group.) Ann Arbor, Mich.: J. W. Edwards, 1946. Pp. vii + 108. (Illustrated.) $1.80.